



# Scalable Peer to Peer Virtual Venue Services for the Access Grid

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# What does Peer to Peer mean in the context of the AG?

- AG is peer to peer like the Web is peer to peer
- Anyone can run a server (“host” virtual spaces)
- Anyone can visit a space on the network
- Global topology links all spaces
- All of this modulo access restrictions, just as in the web
- Why have servers distinct from clients?
  - Persistence
  - Simplicity (for clients)
  - Weight (of servers)
  - Groove model? (Synchronized shared spaces)



# Places! Things! People!



- 6 million road segments in US road database
- Over 24 million web servers, December 2000
- 100 million street addresses
- 130 million people watched the SuperBowl
- 600 million cell phones / year
- 1 – 100 billion non-digital “places”



# Design goals



- Extreme scalability
  - 1 Million nodes
  - Many Million virtual spaces
- Strong security
- Open architecture
  - Multiple implementations
- Reference implementations available
- Closed implementations possible
- Community saturation
  - Trivial to create new spaces



# What are the Venues services?



- **Spatial Metaphor**
  - Interaction scoping
  - Fabric of the virtual space
- **Persistence**
  - Media streams / multicast address assignments
  - Documents
  - Objects
  - MUD / Text communication
- **Security information**
  - Session keys
  - Private / Public keys
  - Certificates
- **Shared application coordination / support**



# Scalability Challenges



Huge numbers of nodes

Identification and Authentication  
Software Distribution

Huge numbers of venues

Multicast address assignment  
Resource Discovery

Huge numbers of nodes in the same venue at the same time

Traffic management  
Multicast routing  
Presentation / Stream Management

Fault tolerance / High Availability

Fallback routing in the network  
Fallback support for media channels  
Replicated services



# How do we do it?



- *Many Community Servers*
  - Identification / Authentication
  - Domain- or institution-specific
- *Many Venue Servers*
  - Provides virtual spaces and persistence
- *Many Nodes*
  - Similar to today's nodes
  - Carry *Credentials* each validated by an issuing Community Server
- *External services*
  - Archiving, translation, transcoding
  - Mapping, indexing, directory services
- *Research questions*
  - Network traffic management
  - Fault Tolerance
  - Replication



# Architecture Sketch: From the 747



Community Server

Venue Server

Node

Node

Venue Server

Node

Venue Server

Node

Community Server



# A Global Space



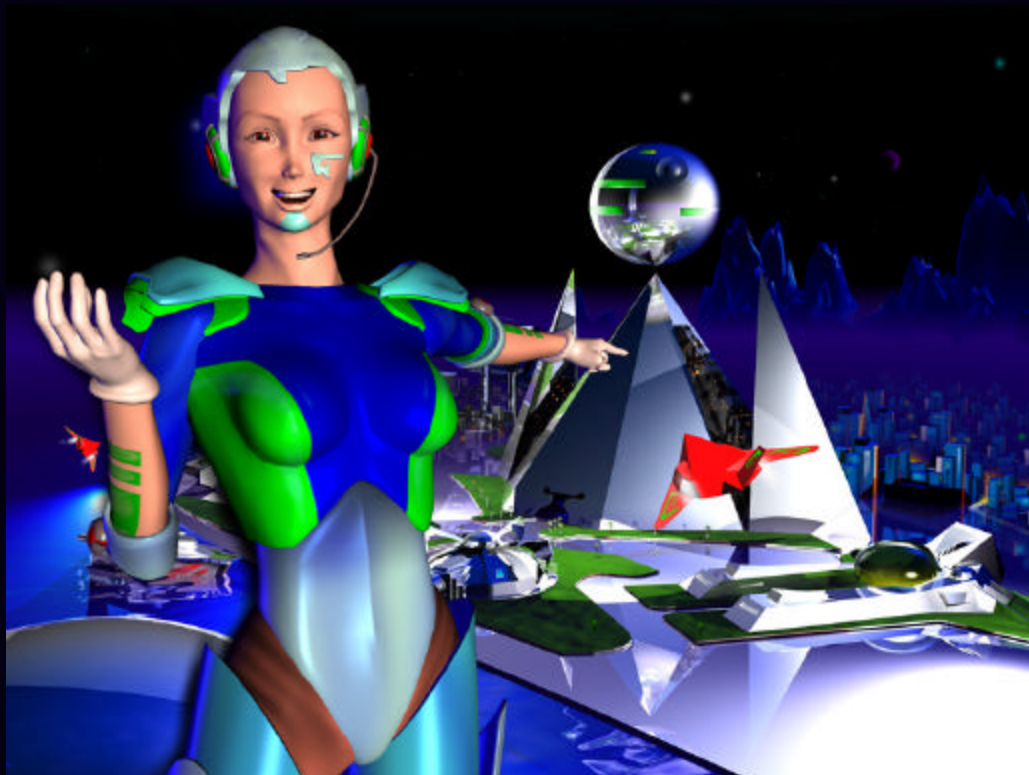
- Community-administered space to which privately-administered spaces are attached
- Leverage Metcalfe's law
  - The usefulness, or utility, of a network equals the square of the number of users.
- Discourage islands
  - Breaks the Metcalfe's law advantage
  - Strong encryption-based authentication to override the usual objections to attachment to the world at large
  - No technical barriers to islands; however, policy or social barriers may form them



# Navigation



- Research question still
  - How to handle very large and complex spaces
- User interfaces may or may not look like web pages
- Industry toying with 3D spaces: Blaxxun Interactive



# Navigation model: issues



- Private areas
- Public areas
- Interlinks – plazas, etc
- Registration of private areas?
- Who governs the public areas
- Who adds private areas to public areas
- Who decides limited access?
- (Zoning?)
- (Property taxes?)



# Architectural abstractions



- Virtual Room / Venue / Space
  - locus for persistence
  - Locus for access control
- Node / physical space
- Door
  - Authentication / access control bound here



# Authentication model



- Multiple mechanisms
  - Don't care at all ... open door / public policy
  - IP source address
  - Username / password
  - Public key cryptography architecture
- Effects of security on usability
  - Keeping track of logins/ passwords
- User authentication vs. Node authentication
  - Private intranet sort of thing



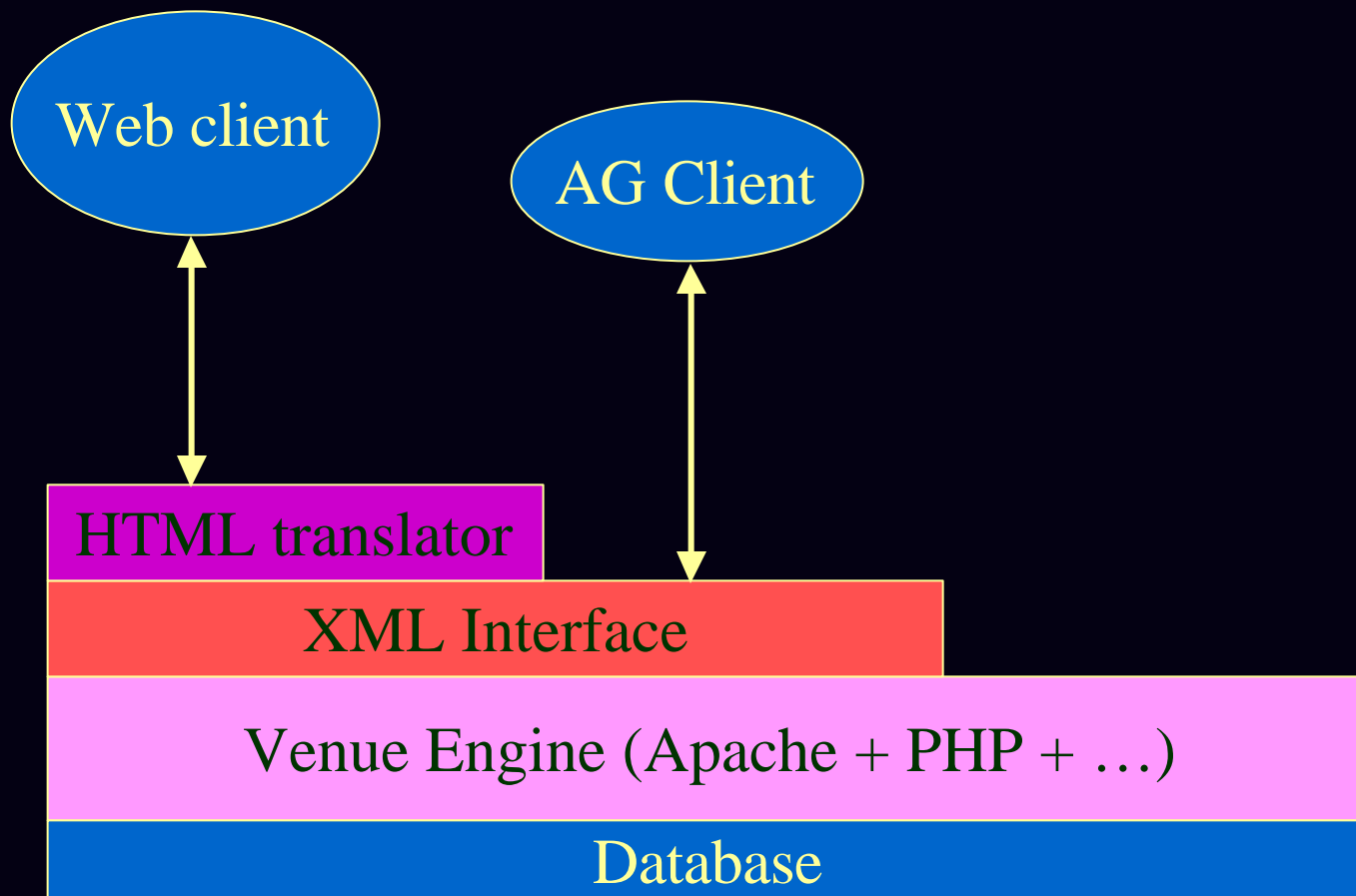
# Strawman Architecture



- Community Server
  - LDAP + Apache + PHP + ...
- Venues server
  - Database + Apache + PHP
  - XML Interface
- Node
  - Integrated client
- Lurkers
  - Web-based interfaced (XML-based)



# Architecture Sketch: Venue Server



# AG Protocols



- Browsing
  - HTTP (current)
  - HTTP + XML document (richer interface)
  - Custom clients?
- Multicast tool address
  - SDP
- Voyager remote control
  - RTSP
  - Corba
- Multimedia streaming
  - RTP
- Shared document control
  - JSDT (current dppt)
  - DAV
  - Corba
  - Custom protocols



# References



- Groove. <http://www.groove.net/>
- Netcraft (web server survey). <http://www.netcraft.com/survey/>
- Blaxxun Interactive. <http://www.blaxxun.com>

